US009058425B2

(12) **United States Patent**
Padmanabhan et al.

(10) **Patent No.: US 9,058,425 B2**
(45) **Date of Patent: Jun. 16, 2015**

(54) **SOFTWARE METRICS ASSESSMENT SYSTEM**

(71) Applicant: **Bank of America Corporation**, Charlotte, NC (US)

(72) Inventors: **Bharani Shangar Padmanabhan**, Concord, CA (US); **Deepan Raja Sachithanandam**, Coimbatore (IN); **Rathi Kaliyan**, Chennai (IN); **Vijayakumar Gurusamy Raju**, Chennai (IN); **Bhargava Srivathsan Gopalakrishnan**, Thanjavur (IN); **Vimal Vijayasekaran**, Charlotte, NC (US)

(73) Assignee: **Bank of America Corporation**, Charlotte, NC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 115 days.

(21) Appl. No.: **14/078,801**

(22) Filed: **Nov. 13, 2013**

(65) **Prior Publication Data**

US 2015/0135168 A1 May 14, 2015

(51) **Int. Cl.**
G06F 9/44 (2006.01)
G06F 11/36 (2006.01)
G06F 17/30 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 11/368*** (2013.01); ***G06F 17/30424*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,549,522	B1 *	10/2013	Chatterjee et al.	718/102
2003/0115323	A1 *	6/2003	Nam	709/224
2006/0075303	A1 *	4/2006	Ulrich et al.	714/38
2008/0040312	A1 *	2/2008	Kolz et al.	707/2
2008/0229284	A1 *	9/2008	Castro et al.	717/124

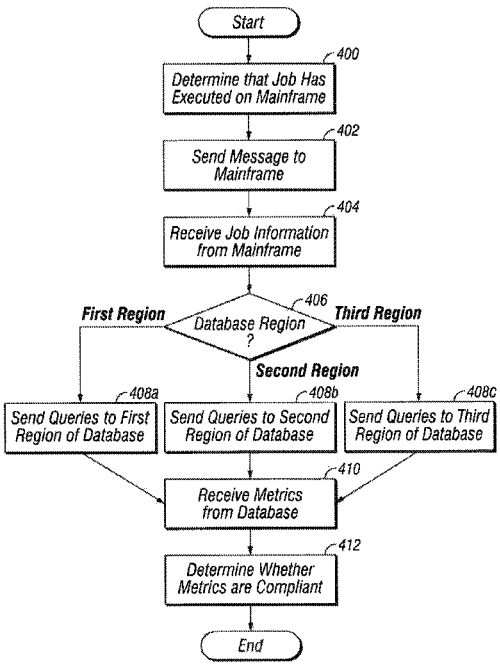
* cited by examiner

Primary Examiner — Don Wong
Assistant Examiner — Daxin Wu
(74) *Attorney, Agent, or Firm* — Michael A. Springs

(57) **ABSTRACT**

An apparatus of one embodiment evaluates a software change and includes an interface, a memory, and a processor. The interface is operable to communicate through a network with a mainframe and a database. The memory is operable to store metrics information. The processor is operable to determine that a job has executed on the mainframe, the job including a program on the mainframe that utilizes the software change and causes first database queries to be sent from the mainframe to the database. The processor is also operable to send a message identifying the job to the mainframe, receive job information associated with the first database queries from the mainframe, generate second database queries based on the job information, send the second database queries to the database, receive metrics associated with the first database queries, and determine whether the metrics information meets one or more compliance standards.

20 Claims, 3 Drawing Sheets



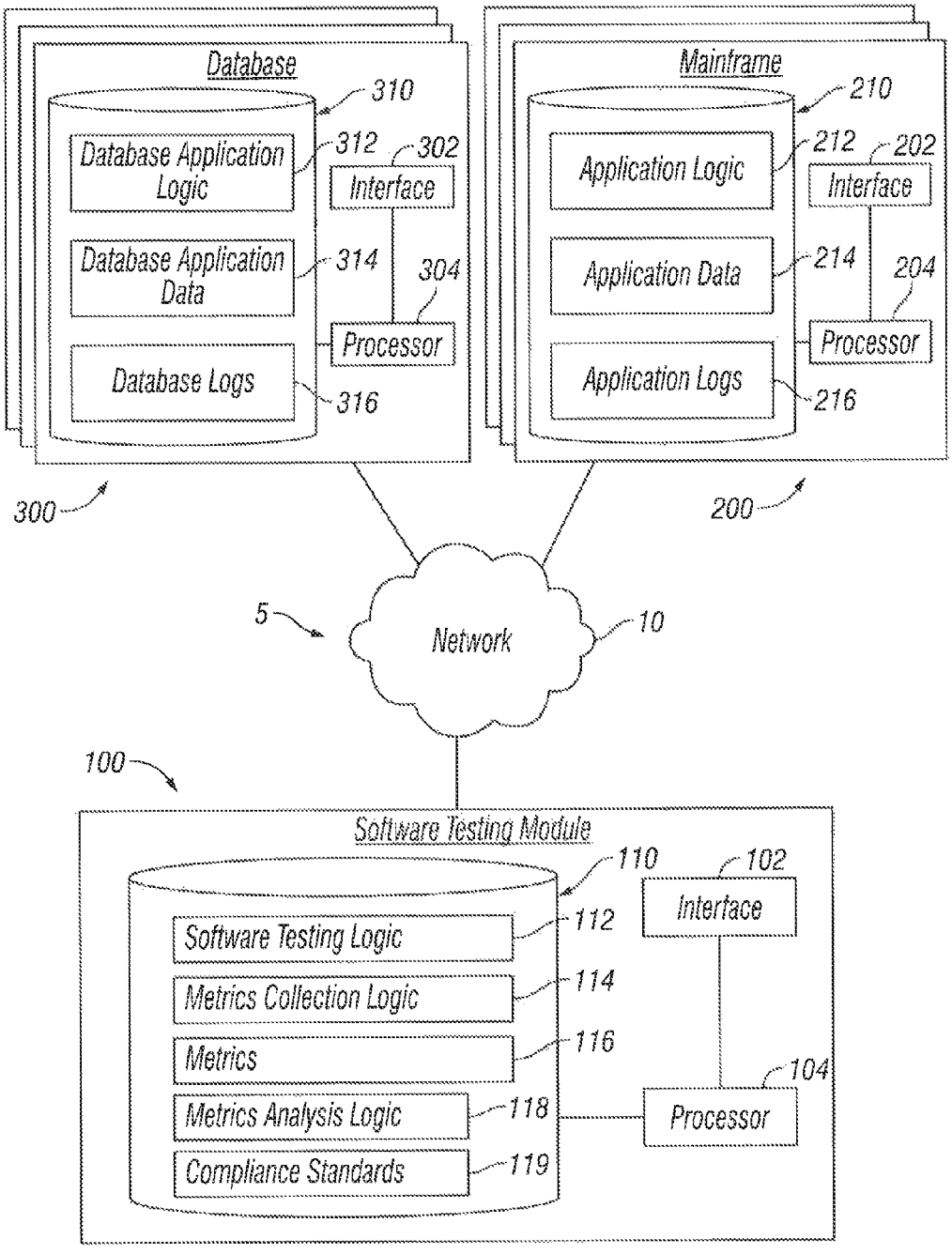

Database
310
Database Application Logic
312
302
Interface
Database Application Data
314
304
Processor
Database Logs
316
300
Mainframe
210
Application Logic
212
202
Interface
Application Data
214
204
Processor
Application Logs
216
200
5
Network
10
100
Software Testing Module
110
102
Interface
Software Testing Logic
112
Metrics Collection Logic
114
Metrics
116
104
Metrics Analysis Logic
118
Processor
Compliance Standards
119

FIG. 1

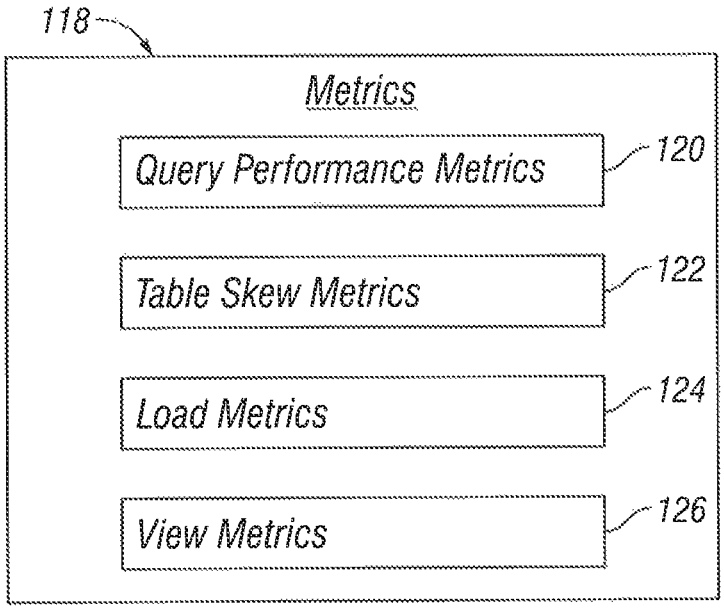

118
Metrics
Query Performance Metrics
120
Table Skew Metrics
122
Load Metrics
124
View Metrics
126

FIG. 2

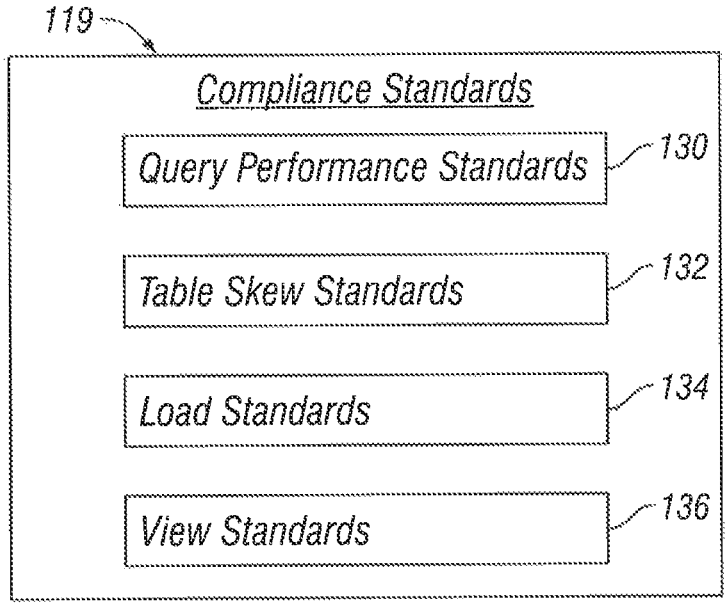

119
Compliance Standards
Query Performance Standards
130
Table Skew Standards
132
Load Standards
134
View Standards
136

FIG. 3

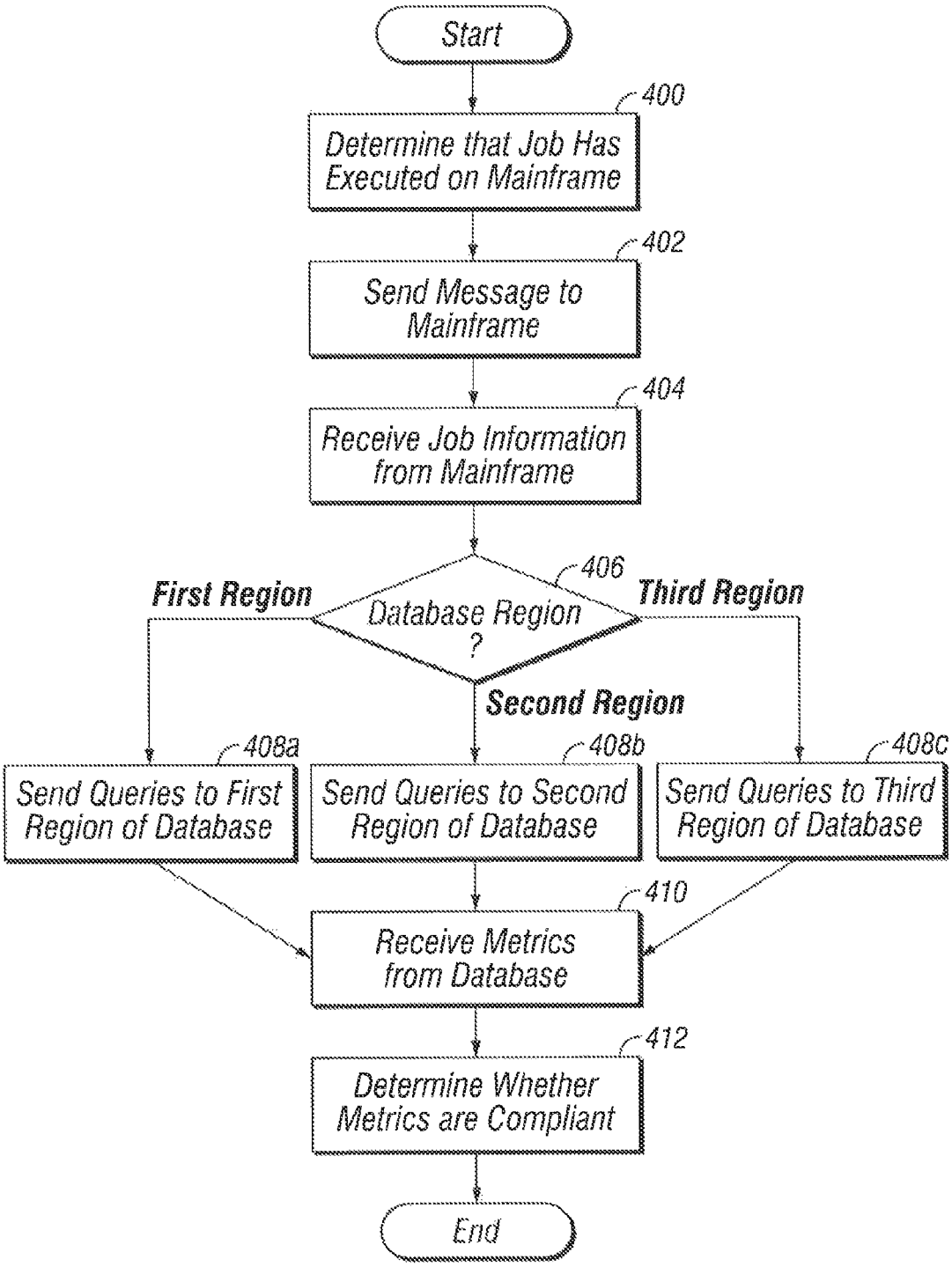

Start
400
Determine that Job Has Executed on Mainframe
402
Send Message to Mainframe
404
Receive Job Information from Mainframe
406
Database Region ?
First Region
Second Region
Third Region
408a
Send Queries to First Region of Database
408b
Send Queries to Second Region of Database
408c
Send Queries to Third Region of Database
410
Receive Metrics from Database
412
Determine Whether Metrics are Compliant
End

FIG. 4

SOFTWARE METRICS ASSESSMENT SYSTEM

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to the field of software development and more particularly to a software metrics assessment system.

BACKGROUND OF THE INVENTION

Software development may involve a development phase, in which software changes are designed and implemented, a user testing phase, in which software changes are subjected to various user tests, and a production phase, in which software changes are put into production after sufficient user testing. Software that is being developed, tested, and put into production may directly or indirectly interact with multiple computer systems, and each of these computer systems may be impacted by software changes. For example, certain computer systems may interact with remote database servers, and software changes on such computer systems may alter the performance of the database servers.

SUMMARY OF THE DISCLOSURE

In accordance with the present invention, certain disadvantages and problems associated with computer development assessments may be reduced or eliminated.

According to one embodiment, an apparatus evaluates a software change and includes an interface, a memory, and a processor. The interface is operable to communicate through a network with a mainframe and a database. The memory is operable to store metrics information. The processor is operable to determine that a job has executed on the mainframe, the job including a program on the mainframe that utilizes the software change and causes first database queries to be sent from the mainframe to the database. The processor is also operable to send a message identifying the job to the mainframe, receive job information associated with the first database queries from the mainframe, generate second database queries based on the job information, send the second database queries to the database, receive metrics associated with the first database queries, and determine whether the metrics information meets one or more compliance standards.

Certain embodiments of the invention may provide one or more technical advantages. A technical advantage of one embodiment may allow for more effective assessment of software changes during the software development process. Certain embodiments may also provide a more efficient and cost-effective mechanism for ensuring that certain standards are met before proceeding with subsequent development, testing, and/or release of software. For example, certain embodiments may provide automated locating and collection of metrics from multiple server regions, which may reduce the time and effort that may otherwise be required for manual review. Some embodiments may provide a dynamic analysis that allows for more flexible and/or streamlined software assessment. For example, certain embodiments may allow for faster and more precise collection of metrics for jobs that run concurrently on the same hardware with other users' jobs. Furthermore, some embodiments may provide improved automated review of software changes while streamlining subsequent review of the software changes by other users. For example, certain embodiments may reduce the likelihood that a non-compliant view is taking up extra system resources or that subsequent reviews are presented with erroneous, misleading, and/or improperly formatted metrics. As another example, certain embodiments may also increase subsequent reviewers confidence that the metrics have not been altered by enforcing certain locking and/or privacy requirements.

Certain embodiments of the invention may include none, some, or all of the above technical advantages. One or more other technical advantages may be readily apparent to one skilled in the art from the figures, descriptions, and claims included herein.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and its features and advantages, reference is now made to the following description, taken in conjunction with the accompanying drawings, in which:

FIG. **1** illustrates an example system that facilitates software metrics assessment;

FIG. **2** illustrates example metrics that may be used to facilitate the evaluation of a software change;

FIG. **3** illustrates example compliance standards that may be utilized during software metrics assessment; and

FIG. **4** illustrates an example software metrics assessment sequence.

DETAILED DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention and its advantages are best understood by referring to FIGS. **1** through **4**, like numerals being used for like and corresponding parts of the various drawings.

In some embodiments, mainframe servers may interact with database servers to provide a distributed computer system. Software changes may be installed on mainframes, and these software changes may impact the performance of one or more aspects of the database servers. For example, software changes may affect one or more database queries made by a mainframe, which may impact the efficiency of database operations, the distribution of data in the database, or various other aspects of the database. When software is executing, various metrics may be captured in logs recorded by the mainframe and/or database. These metrics may be associated with a particular user who executed the software, for example, by running one or more "jobs." After a software change is executed, a software testing module may connect is to the mainframe to determine information about the jobs, and this information may enable the software testing module to generate database queries that can be sent to the database to retrieve metrics associated with the job. The software testing module may then determine whether the metrics meet one or more compliance standards.

FIG. **1** illustrates an example system **5** that facilitates software assessment. System **5** includes software testing module **100**, which communicates with mainframe **200** and database **300** through network **10** to analyze the impact of a software change on one or more components of system **5**.

As used herein, the term "software change" refers to one or more pieces of new or changed software code. Software changes may include software that is designed and/or implemented from scratch; software "updates" that involve adding to, deleting, and/or modifying existing software; or any other type of software. Software encompasses source code, compiled code, or any other type of software, and software may be written in any software language and/or format. For example software changes may include database queries and/or other programs that run such queries. Software changes may apply to any part of the software development process including,

but not limited to, a development phase, a user testing phase, and a production phase. Furthermore, reference to different phases of software development is not meant to imply that the tasks involved with various phases are mutually exclusive. For example, the user testing may occur during the development and/or production phases and on development and/or production platforms.

As used herein, the term "job" refers to one or more programs that include and/or interact with a software change. Jobs may involve isolated applications or applications that communicate with other applications and/or computer systems. For example, a job may involve running a program on software testing module **100** that communicates with an application executing on mainframe **200** and/or causing, mainframe **200** to send one or more queries to database **300**. A job may be associated with a user who ran the job, and a job may have a start and end time. Jobs may also be associated with various logs that may be stored on software testing module **100**, mainframe **200**, database **300**, and/or any suitable computer system.

Network **10** represents any suitable network operable to facilitate communication between the components of system **5**. Network **10** may include any interconnecting system capable of transmitting audio, video, signals, data, messages, or any combination of the preceding. Network **10** may include all or a portion of a public switched telephone network (PSTN), a public or private data network, a local area network (LAN), a metropolitan area network (MAN), a wide area network (WAN), a local, regional, or global communication or computer network such as the Internet, a wireline or wireless network, an enterprise intranet, any other suitable communication link, including combinations thereof operable to facilitate communication between the components.

Software testing module **100** represents any suitable components that facilitate the assessment of a software change in system **5**. Software testing module **100** may include a network server, remote server, mainframe, host computer, workstation, web server, personal computer, file server, or any other suitable device operable to communicate with other devices and process data. In some embodiments, software testing module **100** may execute any suitable operating system such as IBM's zSeries/Operating System (z/OS), MS-DOS, PC-DOS, MAC-OS, WINDOWS, UNIX, OpenVMS, Linux or any other appropriate operating systems, including future operating systems. The functions of software testing module **100** may be performed by any suitable combination of one or more servers or other components at one or more locations. In the embodiment utilizing servers, the servers may be public or private servers. The server may include one or more servers at the same or at remote locations. Software testing module **100** may also include any suitable component that functions as any of the above components. For example, certain embodiments may utilize one or more virtual components, such as a virtual machine. In some embodiments, mainframe **200** and/or database **300** may be integrated with software testing module **100**, or they may operate as part of the same device or devices.

In the illustrated embodiment, software testing module **100** includes network interface **102**, processor **104**, and memory **110**.

Network interface **102** represents any suitable device operable to receive information from network **10**, transmit information through network **10**, perform suitable processing of the information, communicate to other devices, or any combination thereof. For example, network interface **102** may facilitate the running of one or more jobs by communicating with mainframe **200** and/or database **300**. As another example, network interface **102** may facilitate the collection of metrics **116** associated with a job or software change by communicating with mainframe **200** and/or database **300**. As another example, network interface **102** may communicate information to one or more display devices to facilitate user interaction with and review of one or more components of software testing module **100**. Network interface **102** represents any port or connection, real or virtual, including any suitable hardware and/or software, including protocol conversion and data processing capabilities, to communicate through a LAN, WAN, or other communication system that allows software testing module **100** to exchange information with network **10**, other software testing modules **100**, mainframe **200**, database **300**, or other components of system **5**.

Processor **104** communicatively couples to network interface **102** and memory **110** and controls the operation and administration of software testing module **100** by processing information received from network interface **102** and memory **110**. Processor **104** includes any hardware and/or software that operates to control and process information. In some embodiments, processor **104** may be a programmable logic device, a microcontroller, a microprocessor, any suitable processing device, or any suitable combination of the preceding. Processor **104** may execute one or more sets of instructions to facilitate the assessment of a software change. For example, processor **104** may execute software testing logic **112** to facilitate the running of one or more jobs. Processor **104** may also execute metrics collection logic **114** to obtain various metrics **116** associated with such jobs. Processor **104** may also execute metrics analysis logic **118** to analyze metrics **116**. Processor **104** may execute any other suitable programs to facilitate the assessment of computer change such as, for example, user interface software to present one or more GUIs to a user.

Memory **110** stores, either permanently or temporarily, data, operational software, or other information for processor **104**, other components of software testing module **100**, or other components of system **5**. Memory **110** includes any one or a combination of volatile or nonvolatile local or remote devices suitable for storing information. For example, memory **110** may include random access memory (RAM), read only memory (ROM), flash memory, magnetic storage devices, optical storage devices, network storage devices, cloud storage devices, solid state devices, or any other suitable information storage device or a combination of these devices. Memory **110** may store information in one or more databases, file systems, tree structures, any other suitable storage system, or any combination thereof. Furthermore, different information stored in memory **110** may use any of these storage systems (e.g., software testing logic **112** may be stored in a file system while metrics **116** arc stored in a relational database). Moreover, any information stored in memory may be encrypted or unencrypted, compressed or uncompressed, and static or editable. While illustrated as including particular modules, memory **110** may include any suitable information for use in the operation of software testing module **100**. In the illustrated embodiment, memory **110** includes software testing logic **112**, metrics collection logic **114**, metrics **116**, metrics analysis logic **118**, and compliance standards **119**.

Software testing logic **112** represents any suitable set of instructions, logic, or code embodied in a computer-readable storage medium and operable to facilitate execution of one or more software changes. Software testing logic **112** may be stored in memory **110** or another memory associated with software testing module **100**. Software testing logic **112**, or portions thereof, may also be embodied in hardware associ-

ated with software testing module **100** or other components of system **5**. Furthermore, the components of software testing logic **112** may be stored in the same or different memories of the same or different software testing modules **100**. Various components of software testing logic **112** may also be stored in different components of system **5**. Software testing logic **112** may be implemented as an application, a component of an application, a plugin for an existing application, a script, an/or any suitable component.

In operation, software testing logic **112** may cause one or more jobs to be run by software testing system **100**, mainframe **200**, and/or database **300**. Software testing logic **112** may communicate with mainframe **200** to cause one or more programs to be executed by mainframe **200**. For example, software testing logic **112** may communicate with application logic **212** to cause mainframe **200** to run one or more jobs. Such jobs may cause mainframe **200** to send one or more queries to database **300**, and logs related to such jobs and/or queries may be stored in application logs **216** as well as database logs **316**. Furthermore, software testing logic **112** may be executed by different users from different software testing systems, which may result in multiple jobs run by different users and overlapping in time. Thus, concurrent execution of different instances of software testing logic **112** may lead to application logs **216** and database logs **316** containing logs that overlap in time and relate to jobs associated with different users.

Metrics collection logic **114** represents any suitable set of instructions, logic, or code embodied in a computer-readable storage medium and operable to facilitate the collection of metrics related to one or more software changes. Metrics collection logic **114** may be stored in memory **110** or another memory associated with software testing module **100**. Metrics collection logic **114**, or portions thereof, may also be embodied in hardware associated with software testing module **100** or other components of system **5**. Furthermore, the components of metrics collection logic **114** may be stored in the same or different memories of the same or different software testing modules **100**. Various components of metrics collection logic **114** may also be stored in different components of system **5**. Metrics collection logic **114** may be implemented as an application, a component of an application, a plugin for an existing application, a script, and/or any suitable component. As a specific example, metrics collection logic **114** may be implemented as a macro in a spreadsheet program (such as, for example, EXCEL).

In operation, metrics collection logic **114** may communicate with mainframe **200** and database **300** to obtain metrics **116**. As explained above, after one or more jobs have been run by mainframe **200** and/or database **300**, mainframe **200** and database **300** may have various logs indicating the efficiency, accuracy, and/or other aspects of the job. Metrics collection logic **114** may obtain one or more portions of these logs from mainframe **200** and database **300**. For example, metrics collection logic **114** may send a message to mainframe **200** identifying one or more jobs that were previously run. This message may be sent in response to input from a user, or it may be sent automatically following execution of software testing logic **112**. The message may identify a job by, for example, including a software test identifier, a user identifier, a start time, an end time, a duration, and/or any suitable information that may allow mainframe **200** to identify one or more jobs.

In some embodiments, metrics collection logic **114** may select a particular mainframe **200** from multiple available mainframes **200** and/or a particular database **300** from multiple available databases **300**. For example, mainframe **200** may include multiple versions, or "regions," handling different types of operation. As a specific example, mainframe **200** and database **300** may contain development, user testing, and production regions operating in parallel. Production regions may store and/or process real world data, while development and user testing regions may store and/or process simulated data to simulate real world operation. Metrics collection logic **114** may determine which region to use automatically, or it may select a region based on user input. In other embodiments, mainframe **200** and/or database **300** may include a single region, and selecting a region may not be necessary.

After sending the message to the appropriate mainframe **200**, metrics collection logic **114** may receive a response from mainframe **200** that includes job information identifying one or more queries that were sent from mainframe **200** to database **300** during the one or more jobs. For example, the job information may include a user identifier, a start time, an end time, a duration, one or more query identifiers indicating which queries were sent to database **300** during the one or more jobs, a database identifier indicating which database **300** processed the queries, database log information indicating where the related logs can be accessed on the relevant database **300**, and/or any suitable information that may allow software testing module **100** to obtain the relevant logs from database **300**. Based on the job information, metrics collection logic may generate one or more queries to be sent to database **300**. Software testing system **100** may therefore provide an efficient mechanism for locating, distinguishing, and retrieving database logs that can be used to evaluate a software change.

After sending the one or more queries to the appropriate database **300**, metrics collection logic **114** may receive a response from database **300** including metrics information related to the one or more jobs. This metrics information, which may be stored as metrics **116**, may indicate the efficiency, accuracy, and/or other aspects of one or more programs impacted by a software change. In some embodiments, the queries sent to database **300** may be tailored such that only metrics information related to the relevant jobs are returned. In other embodiments, metrics information unrelated to the relevant jobs may be returned as well, and metrics collection logic **114** may modify, delete, ignore, and/or otherwise process the metrics information to facilitate analysis of the relevant metrics information.

Metrics **116** include any suitable information indicating the efficiency, speed, accuracy, effectiveness, or any other suitable aspect of a software change or its impact on a computer system. In some embodiments, metrics **116** may indicate the performance of the software with respect to a particular computer system, such as database **300**. For example, software changes may affect one or more database queries made by mainframe **200** to database **300**, which may impact the efficiency of database operations, accuracy and/or distribution of data in the database, and/or various other aspects of database **300**. Such metrics may include query performance metrics **120**, table skew metrics **122**, load metrics **124**, and view metrics **126**, which are discussed further below with respect to FIG. **2**. Metrics **116** may include metrics information associated with one or more software changes, one or more jobs, and/or one or more users. Metrics **116** may provide a more efficient mechanism for evaluating the performance of a software change and/or determining whether a software change is compliant with one or more standards.

Metrics analysis logic **118** represents any suitable set of instructions, logic, or code embodied in a computer-readable storage medium and operable to facilitate the analysis of metrics related to one or more software changes, such as

metrics **116**. Metrics analysis logic **118** may be stored in memory **110** or another memory associated with software testing module **100**. Metrics analysis logic **118**, or portions thereof, may also be embodied in hardware associated with software testing module **100** or other components of system **5**. Furthermore, the components of metrics analysis logic **118** may be stored in the same or different memories of the same or different software testing modules **100**. Various components of metrics analysis logic **118** may also be stored in different components of system **5**. Metrics analysis logic **118** may be implemented as an application, a component of an application, a plugin for an existing application, a script, and/or any suitable component. As a specific example, metrics analysis logic **118** may be implemented as a macro in a spreadsheet program (such as, for example, EXCEL).

In operation, metrics analysis logic **118** may determine whether one or more portions of metrics **116**, and/or an associated software change, meet one or more compliance standards **119**. For example, metrics analysis logic **118** may analyze compliance standards **119** related to query performance, table skew, load statistics, and/or database views. In some embodiments, metrics analysis logic **118** may dynamically determine which compliance standards **119** to evaluate and/or how to evaluate them. For example, certain standards or types of standards may be specifically selected for review or excluded from review based on one or more aspects of the software change and/or job being evaluated. As another example, the rubric used to evaluate a particular metric **116** may be adjusted based on one or more aspects of the associated job. As a specific example, a job that queries an extremely large table may be expected to run more slowly than a job that queries a small table, and metrics analysis logic **118** may adjust its assessment of the resulting metrics accordingly. Metrics analysis logic **118** may therefore provide a dynamic analysis that allows for more flexible and/or streamlined software assessment.

Based on the analysis of metrics **116**, metrics analysis logic **118** may determine that a software change or a job is compliant or noncompliant. In some embodiments, compliance or noncompliance may be granular such that different metrics may be identified as compliant or noncompliant. Furthermore, compliance may be evaluated using any appropriate scale. For example, compliance may be binary such that metrics analysis logic **118** identifies a software change or a job as either compliant or noncompliant, or compliance may be evaluated along a scale or any other suitable rubric. Other embodiments may utilize a 0-10 scale, a pass-fail scale, a color-coded scale, any other scale suitable for compliance scoring, or any combination thereof. Once the compliance analysis has been performed, it may be presented to a user in any suitable manner. For example, compliance scores may be reported on a spreadsheet, presented via a GUI on a display device connected to software testing system **10**, communicated via email or other suitable alerts, or presented in any other suitable manner. The analysis may also be presented to one or more users for subsequent evaluation. For example, users may review the compliance analysis to ensure its accuracy, override one or more portions of its analysis, and/or perform additional analyses. Reporting the compliance analysis in this manner may allow software testing, module **100** to efficiently provide automated review of software changes while streamlining subsequent review of the metrics and/or the metrics analysis by users.

Compliance standards **119** represent any suitable standard for evaluating one or more aspects of metrics **116**. For example, compliance standards **119** may include standards related to query performance (e.g., whether a job meets a certain level of efficiency), table skew (e.g., whether a job results in a sufficiently even distribution of data across various tables of database **300**), load statistics (e.g., whether job timing, the volume of data handled, and/or the database utilities used during the job are acceptable), and/or database views (e.g., whether the formatting, parameters, and/or meta data associated with database views are correct). These standards may provide an efficient mechanism for automatically assessing the performance of a software change across a broad range of factors. Compliance standards **119** are discussed further below with respect to FIG. **3**.

Mainframe **200** represents any suitable components that are operable to run applications and communicate with software testing system **100** and database **300** through network **10**. Mainframe **200** may include a network server, remote server, mainframe, host computer, workstation, web server, personal computer, file server, or any other suitable device operable to communicate with other devices and process data. In some embodiments, mainframe **200** may execute any suitable operating system such as IBM's zSeries/Operating System (z/OS), MS-DOS, PC-DOS, MAC-OS, WINDOWS, UNIX, OpenVMS. Linux or any other appropriate operating systems, including future operating systems. The functions of mainframe **200** may be performed by any suitable combination of one or more servers or other components at one or more locations. In the embodiment where the modules are servers, the servers may be public or private servers, and each server may be a virtual or physical server. The server may include one or more servers at the same or at remote locations. For example, mainframe **200** may operate logically as a single server while operating across two or more physical servers. Mainframe **200** may also include any suitable component that functions as a server. In some embodiments, one or more portions of software testing module **100** and/or database **300** may be integrated with mainframe **200**, or they may operate as part of the same device or devices.

In some embodiments, mainframe **200** may include multiple versions or regions handling different types of operation. As a specific example, mainframe **200** may contain development, user testing, and production regions operating in parallel. Production regions may store and/or process real world data, while development and user testing regions may store and/or process simulated data to simulate real world operation. Other embodiments may not include multiple regions. Different versions of mainframe **200** may operate on the same or different physical and/or virtual machines. In some embodiments, a particular region of mainframe **200** may communicate with a particular region of database **300**. For example, a user testing region of mainframe **200** may utilize a user testing region of database **300** and vice versa. Furthermore, in some embodiments a single region of mainframe **200** may be operable to utilize multiple regions of database **300**, and in some embodiments multiple regions of mainframe **200** may be operable to utilize a single region of database **300**. In embodiments having multiple regions, a particular region of mainframe **200** may be selected automatically by software testing system **100** based on one or more parameters, or a user may select the region explicitly via user input. Providing access to multiple regions of mainframe **200** via a single software testing system **100** may provide simplified and/or streamlined access to different software testing environments.

In the illustrated embodiment, mainframe **200** includes network interface **202**, processor **204**, and memory **210**.

Network interface **202** represents any suitable device operable to receive information from network **10**, transmit information through network **10**, perform suitable processing of

the information, communicate to other devices, or any combination thereof. For example, network interface **202** may facilitate the communication of one or more portions of application logs **216** to software testing module **100**. Network interface **202** may also receive information from other computer systems, such as software testing module **100** or database **300**. Network interface **202** represents any port or connection, real or virtual, including any suitable hardware and/or software, including protocol conversion and data processing capabilities, to communicate through a LAN, WAN, or other communication system that allows mainframe **200** to exchange information with network **10**, software testing module **100**, other project modules **200**, database **300**, or other components of system **5**.

Processor **204** communicatively couples to network interface **202** and memory **210**, and controls the operation and administration of mainframe **200** by processing information received from network interface **202** and memory **210**. Processor **204** includes any hardware and/or software that operates to control and process information. For example, processor **204** may execute application logic **212** to execute various applications and communicate with software testing module **100** and database **300**. Processor **204** may be a programmable logic device, a microcontroller, a microprocessor, any suitable processing device, or any suitable combination of the preceding.

Memory **210** stores, either permanently or temporarily, data, operational software, or other information for processor **204**, other components of mainframe **200**, or other components of system **5**. Memory **210** may include any component discussed above regarding memory **110**. Memory **210** may store information in one or more databases, file systems, tree structures, any other suitable storage system, or any combination thereof. Furthermore, different information stored in memory **210** may use different types of storage systems. Moreover, any information stored in memory may be encrypted or unencrypted, compressed or uncompressed, and static or editable. While illustrated as including particular modules, memory **210** may include any suitable information for use in the operation of mainframe **200**. In the illustrated embodiment, memory **210** includes application logic **212**, application data **214**, and application logs **216**.

Application logic **212** represents any suitable set of instructions, logic, or code embodied in a computer-readable storage medium and operable to facilitate the execution of one or more applications. Application logic **212** may be stored in memory **110** or another memory associated with mainframe **200**. Application logic **212**, or portions thereof, may also be embodied in hardware associated with software testing module **100** or other components of system **5**. Furthermore, the components of application logic **212** may be stored in the same or different memories of the same or different mainframes **200**. Various components of application logic **212** may also be stored in different components of system **5**.

In operation, application logic **212** implements one or more applications running mainframe **200**. Application logic **212** may consist of multiple applications. For example, application logic **212** may include applications that communicate with database **300** to store, access, search, or otherwise use one or more portions of database application data **314**. Data received from database **300** or otherwise accessed by mainframe **200** may be stored as application data **214**. One or more applications may receive one or more messages from software testing logic **112**. Such messages may trigger the running of one or more jobs, which may involve sending one or more queries to database **300**. Information associated with such jobs may be stored in application logs **216**.

Application data **214** includes any suitable information that may be stored, accessed by, or processed by one or more applications in application logic **212**. Application data **214** may include application state, data received from database **300** or software testing module **100**, or any suitable data. For example, during the normal operation of mainframe **200**, application logic **212** may query database **300** to retrieve information that may then be stored, permanently or temporarily, as application data **214**.

Application logs **216** include any suitable information operable to facilitate collection of metrics related to one or more jobs from database **300** by software testing system **100**. Application logs may also include any logs stored during the operation of application logic **210**. For example, when application logic **212** runs a job, information about the job may be stored in application logs **216**. Such information may include a user identifier of the user who ran the job, a start time of the job, an end time job, a duration of the job, one or more query identifiers indicating which queries were sent to database **300** during the job, a database identifier indicating which database **300** processed the queries, database log information indicating where the related logs can be accessed on the relevant database **300**, and/or any suitable information that may allow software testing module **100** to obtain the relevant logs from database **300**. Metrics collection logic **114** may send one or more messages requesting one or more portions of application logs **216**, and application logic **212** may analyze application logs **216** to identify and return the relevant job information. This job information may allow software testing module **100** to query database **300** to obtain metrics related to the job.

Database **300** represents any suitable components that maintain information and perform processing relating to applications. Database **300** may include a network server, remote server, mainframe, host computer, workstation, web server, personal computer, file server, or any other suitable device operable to communicate with other devices and process data. In some embodiments, database **300** may execute any suitable operating system such as IBM's zSeries/Operating System (z/OS), MS-DOS, PC-DOS, MAC-OS, WINDOWS, UNIX, OpenVMS, Linux or any other appropriate operating systems, including future operating systems. In certain embodiments, database **300** may be a dedicated database server. For example, in a particular embodiment, database **300** may be a TERADATA server. The functions of database **300** may be performed by any suitable combination of one or more servers or other components at one or more locations. In the embodiment where the modules are servers, the servers may be public or private servers, and each server may be a virtual or physical server. The server may include one or more servers at the same or at remote locations. For example, database **300** may operate logically as a single server while operating across two or more physical servers. Database **300** may also include any suitable component that functions as a server. In some embodiments, software testing module **100** and/or mainframe **200** may be integrated with database **300**, or they may operate as part of the same device or devices.

In the illustrated embodiment, database **300** includes network interface **302**, processor **304**, and memory **310**.

Network interface **302** represents any suitable device operable to receive information from network **10**, transmit information through network **10**, perform suitable processing of the information, communicate to other devices, or any combination thereof. For example, network interface **302** may facilitate the communication of one or more portions of database application data **314** to mainframe **200** and may facilitate

the communication of one or more portions of database logs **316** to software testing module **100**. Network interface **302** may also receive information from other computer systems, such as software testing module **100** or mainframe **200**. Network interface **302** represents any port or connection, real or virtual, including any suitable hardware and/or software, including protocol conversion and data processing capabilities, to communicate through a LAN, WAN, or other communication system that allows database **300** to exchange information with network **10**, software testing module **100**, mainframe **200**, other application modules **300**, or other components of system **5**.

Processor **304** communicatively couples to network interface **302** and memory **310**, and controls the operation and administration of database **300** by processing information received from network interface **302** and memory **310**. Processor **304** includes any hardware and/or software that operates to control and process information. For example, processor **304** may execute database application logic to facilitate the communication with software testing module **100** and/or mainframe **200** as described above. Processor **304** may be a programmable logic device, a microcontroller, a microprocessor, any suitable processing device, or any suitable combination of the preceding.

Memory **310** stores, either permanently or temporarily, data, operational software, or other information for processor **304**, other components of database **300**, or other components of system **5**. Memory **310** may include any component discussed above regarding memory **110**. Memory **310** may store information in one or more databases, file systems, tree structures, any other suitable storage system, or any combination thereof. Furthermore, different information stored in memory **310** may use different types of storage systems. Moreover, any information stored in memory may be encrypted or unencrypted, compressed or uncompressed, and static or editable. While illustrated as including particular modules, memory **310** may include any suitable information for use in the operation of database **300**. In the illustrated embodiment, memory **310** includes database application logic **312**, database application data **314**, and database logs **316**.

Database application logic **312** represents any suitable set of instructions, logic, or code embodied in a computer-readable storage medium and operable to perform database functions. Database application logic **312** may be stored in memory **110** or another memory associated with database **300**. Database application logic **312**, or portions thereof, may also be embodied in hardware associated with software testing module **100** or other components of system **5**. Furthermore, the components of database application logic **312** may be stored in the same or different memories of the same or different databases **300**. Various components of database application logic **312** may also be stored in different components of system **5**.

In operation, database application logic **312** facilitates various database operations. For example, database application logic may handle queries received from software testing module **100** and mainframe **200**. Database application logic **312** may also be operable to store information in data application data **314** and store metrics and other log information in database logs **316**. Furthermore, database application logic **312** may receive one or more messages from metrics collection logic **114** requesting one or more portions of database application data **314** and/or database logs **316**, and database application logic **312** may identify and return such information.

Database application data **314** includes any suitable information that may be stored, accessed by, or processed by database application logic **212**. Database application data **314** may include data used by one or more applications of application logic **212**. As a specific example, database application data **314** may include various tables that can be accessed and updated by mainframe **200** and/or software testing module **100**. For example, database application logic **312** may receive one or more queries from mainframe **200** related to one or more jobs. In processing such queries, database application logic **312** may add, delete, modify, and/or otherwise affect database application data **314**. Logs associated with such queries may be stored in database logs **316**.

Database logs **316** include any suitable information related to the operations of database **300** during a job. Such information may include information related to one or more jobs that may be retrieved as part of a metrics collection process by software testing system **100**. For example, when application logic **212** runs a job, information about the job may be stored in application logs **216**. Such information may include information related to query performance, table skew, load statistics, and/or database views. Metrics collection logic **114** may send one or more messages requesting one or more portions of this information, and database application logic **312** may analyze database logs **316** to identify and return the relevant metrics. Database logs **316** may therefore provide raw data that can be analyzed to determine whether a software change meets one or more compliance standards **119**.

In an exemplary embodiment of operation, software testing module **100** may initiate execution of a software change by sending a request to mainframe **200** to run a job. The job may involve mainframe **200** sending one or more queries to database **300**, and mainframe **200** and database **300** may store logs associated with the job in application logs **216** and database logs **316**, respectively. Software testing module **100** may then send a request to mainframe **200** for job information associated with the job, and mainframe **200** may respond with the relevant portions of application logs **216**. Based on this job information, software testing module **100** may generate one or more queries and send these queries to database **300**, and database **300** may respond with one or more portions of database logs **316** that are associated with the job. Software testing module **100** may store one or more portions of this information as metrics **116**. Software testing module **100** may also determine whether one or more portions of metrics **116** are compliant with one or more compliance standards **119**. Such analysis may be used to evaluate the metrics themselves and/or the software change or job that resulted in the generation of metrics **116**. If metrics **116** are determined not to be in compliance, one or more error messages may be generated and communicated to a user. In some embodiments, once compliance standards **119** have been evaluated, and metrics **116** are determined to be in compliance, metrics **116** may be communicated to another user for additional manual analysis.

Modifications, additions, or omissions may be made to system **5** without departing from the scope of the invention. For example, system **5** may implement computer assessment procedures different from or in addition to those described herein. As another example, multiple software testing modules **100** may operate in parallel to facilitate standards compliance. As yet another example, software testing logic **112** may be configurable by a user of software testing module **100**, which may facilitate the modification of existing rules, deletion of existing rules, or insertion of additional rules. System **5** may include any number of networks **10**, software testing modules **100**, project modules **200**, and application modules **300**. Any suitable logic may perform the functions of system **5** and the components within system **5**.

FIG. **2** illustrates example metrics **116** that may be used to facilitate the evaluation of a software change. FIG. **3** illustrates example compliance standards **119** that may be evaluated during software assessment. Metrics **116** may be evaluated against corresponding compliance standards **119**. In the illustrated embodiments, metrics **116** include query performance metrics **120**, table skew metrics **122**, load metrics **124**, and view metrics **126**. Similarly, compliance standards **119** include query performance standards **130**, table skew standards **132**, load standards **134**, and view standards **136**.

Query performance metrics **120** may include any suitable data indicating the efficiency of a job. Such metrics may indicate the impact of a job on the performance of database **300**. For example, a query (e.g., a query made by mainframe **200** during the job) that is not sufficiently tuned may result in higher CPU and/or other resource utilization by database **300**. Data that might be retrieved from database **300** and included in query performance metrics **120** includes a user identifier of the user that ran the query, the application of mainframe **200** that was used to submit the query, a query identifier that identifies which query was run, the text of the query itself, start and end times, the duration of the query, the number of rows returned in the result set, the amount of time processor **304** was used for the query, and/or the amount of IO used for the query. Data may also include other CPU and IO information, the amount of spool used by the query, the number of virtual processors used by database **300** (e.g., the number of Access Module Processors ("AMPs") in a TERADATA system), and/or any other suitable information. Metrics analysis logic **118** may use such data to determine whether a software change or a job is compliant with one or more query performance standards **130**. For example, query performance standards **130** may indicate that a particular type of query should not exceed a certain level of CPU and/or IO usage.

Table skew metrics **122** may include any suitable data indicating the effect of a job on the distribution of one or more tables in database **300**. These metrics may indicate how database application data **314** is distributed across various nodes of database **300**. Table skew metrics **122** may include data such as the table name, the database name where the table is located, the amount of space the table is using, information indicating how the table size compares to other table sizes, and/or various counts associated with the table (e.g., counts for the number of referential integrity rules are active on the table, the number of active constraints on the table, the number of triggers on the table, the number of columns on the table, and/or the number of unused columns on the table). Table skew metrics **122** may also include information indicating the type of the primary index, the number and/or cardinality of the secondary indexes, whether or not the table is compliant with various skewing standards, the number of virtual processors operating on database **300**, and/or any other suitable information. Metrics analysis logic **118** may use such data to determine whether a software change or a job is compliant with one or more table skew standards **132**. For example, evaluating table skew metrics **122** based on table skew standards **132** may indicate that a particular table impacted by a job is non-compliant. As another example, table skew standards **132** may be used to evaluate whether a job results in tables with data that is distributed too unevenly.

Load metrics **124** may include any suitable data related to the job itself and its interaction with database **300**. Load metrics **124** may also provide information about a process of database **300** that was used to handle the job. For example, load metrics may include data such as the name of the job or a subpart of the job, a session identifier, start times and/or end times of the process, elapsed times required for running of the process or a particular portion of the process, the number of records input and/or output by a process, the total impact of the job or process on the CPU and/or I/O operations of database **300**, a percentage of the total or expected volume of data that was processed during the job, and/or the number of virtual processors in database **300**. Load metrics **124** may also indicate the type of process or utility used by database **300** to handle the job. For example, in embodiments utilizing a TERADATA server, the types of processes may include MLOAD, FastLoad, BTEQ, FastExport, TPT, or other suitable process types. Evaluation of load metrics **124** based on load standards **134** may allow software testing module **100** to determine whether a job is efficiently handling database utilities. As a specific example, load standards **134** may suggest that a job is non-compliant if the job utilized a database utility other than a prescribed utility given the volume of data processed.

View metrics **126** may include any suitable information associated with the formatting, parameters, and/or metadata of a view. A view is an image of data contained in a table that is created over top of the table. A view may be a result set of a query and may therefore include all, some, or none of the items in a table or database. The view reflected in view metrics **126** may be a view of metrics **116**. For example, one or more portions of metrics **116** may be generated by sending one or more queries to database **300**, and the view may be the result of such queries. View metrics **126** may therefore include metadata about metrics **116**. View metrics **126** may be evaluated against view standards **136** to ensure that views are formed in a particular way. View standards **136** may also ensure that privacy settings and locks are set as prescribed. View metrics **126** may include data such as the database name where the view is housed, the name of the view, the name of one or more views related the view, a number of virtual processors in database **300**, and/or information indicating one or more parameters of the view. Such information may indicate whether the view is using a replace command, whether one more rows of the view are locked, whether a union operator was used in the query that formed the view, whether the view is performing a full outer join, and/or whether the view complies with a privacy policy. View metrics **126** and view standards **136** may provide improved software metrics analysis by reducing the likelihood that a non-compliant view is taking up extra system resources. Embodiments that enforce locking and/or privacy requirements may also provide improved software metrics analysis by increasing reviewers' confidence that metrics **116** have not been altered.

FIG. **4** is a diagram that illustrates an example software metrics analysis sequence of software testing module **100**.

At step **400**, software testing module **100** determines that a job has executed on mainframe **200**. This determination may occur automatically following the execution of the job. For example, a user of software testing module **100** may initiate the job, and software testing module **100** may be configured to automatically determine when the job is complete to trigger subsequent metrics analysis. This determination does not necessarily require that the job be complete or that software testing module **100** make an explicit determination. For example, in embodiments where software testing module **100** does not automatically proceed to step **402** after initiating the job, a user may provide input to software testing module **100** causing the sequence to proceed to step **402**. In some embodiments, this step may be omitted entirely. Following the determination, the sequence proceeds to step **402**.

At step **402**, software testing module **100** sends a first message to mainframe **200** to request information that will allow it to build one or more database queries to retrieve

metrics related to the job from database **300**. The first message may contain information identifying the job such as, for example, a user identifier, a start time, an end time, a duration, a job identifier, or any other suitable information that may allow mainframe **200** to determine which job is being sought. Based on this information, mainframe **200** may retrieve job-related information from application logs **216**. Furthermore, in some embodiments, software testing module **100** may select a particular version or region of mainframe **200**. For example, mainframe **200** may have a development region, a testing region, a production region, and/or any other suitable region. In such embodiments, the selection may be made by a user, or the selection may occur automatically based on one or more factors such as, for example, the region of mainframe **200** on which the job was previously run.

At step **404**, software testing module **100** receives a response from mainframe **200**. This response may include job information associated with one or more first database queries that were previously sent from mainframe **200** to database **300** as part of the job. This job information may include a user identifier, a start time, an end time, a duration, a job identifier, a query type, query text, a database name, a table name, or any other suitable information that will enable software testing module to generate database queries. After receiving this response from mainframe **200**, software testing module **100** proceeds to step **406**.

At step **406**, software testing module **100** may determine which version or region of database **300** to use. Some embodiments may not utilize multiple regions of database **300**, and in such embodiments, step **406** may be omitted. In other embodiments, software testing module **100** may select the appropriate region based on various factors. For example, mainframe **200** may provide information indicating which database region it used during the running of the job. As another example, in embodiments where a user selects which the region in which to run the job initially, software testing module **100** may store region information to properly direct subsequent metrics queries. In the illustrated embodiment, database **300** is shown to have three regions, but other embodiments may use any suitable number of regions. For example, various embodiments may utilize one, two, three, five, ten, or any suitable number of regions. In the illustrated example with three regions, if software testing module **100** determines that the appropriate region is the first, second, or third, it proceeds to steps **408***a*, **408***b*, or **408***c*, respectively.

At steps **408***a-c*, software testing module **100** generates and sends database queries to the appropriate region of database **300** to obtain metrics information regarding the job. These queries may be generated based on the job information received from mainframe **200** during step **404**. For example, the job information may indicate that particular queries were previously sent with a particular user identifier and a particular time. Based on this information, software testing module **100** may automatically generate one or more database queries that are constructed to retrieve metrics information from database **300** related to the previously sent queries. After generating and sending the database queries to the appropriate region of database **300**, software testing module **100** may proceed to step **410**.

At step **410**, software testing module **100** receives a response to the database queries sent during step **408**. This response may contain metrics information that was retrieved by database **300** from database logs **316**. This information may include any type of information discussed above with respect to metrics **116** in FIG. **1** or **2**, in some embodiments, metrics **116** may be presented to a user via any suitable mechanism. For example, metrics **116** may be presented in a spreadsheet that is organized to present various categories of information. Upon receiving the metrics information from database **300**, software testing module **100** may proceed to step **412**.

At step **412**, software testing module **100** determines whether one or more portions of metrics **16** are compliant with one or more compliance standards **119**. Compliance may be determined as discussed above with respect to FIGS. **2** and **3**. Various embodiments may evaluate compliance of metrics **116** differently. For example, some embodiments may determine the formatting of metrics **116** (for example, data presented in a spreadsheet) is compliant to automatically detect errors before sending metrics **116** to another computer system or another user for review. Other embodiments may analyze metrics **116** to assess substantive as well as formal compliance. For example, software testing module **100** may automatically evaluate the efficiency, accuracy, and/or other aspects of a job's performance. By providing automatic assessment of metrics **116**, software testing module **100** may provide faster, more reliable, and more thorough analysis of software changes.

Various embodiments may perform some, all, or none of the steps described above. For example, certain embodiments may omit steps **400**, **406**, and/or **412** under certain conditions, or they may omit these steps entirely. Furthermore, certain embodiments may perform these steps in different orders or in parallel. Moreover, one or more steps may be repeated. For example, this sequence may be performed once during the design phase of the software change and then performed again during the build phase of the software change. While discussed as software testing module **100** performing these steps, any suitable component of system **5** may perform one or more steps of the method.

Herein, "or" is inclusive and not exclusive, unless expressly indicated otherwise or indicated otherwise or indicated otherwise by context. Therefore, herein, "A or B" means "A, B, or both," unless expressly indicated otherwise or indicated otherwise by context. Moreover, "and" is both joint and several, unless expressly indicated otherwise or indicated otherwise by context. Therefore, "A and B" means "A and B, joint or severally," unless expressly indicated otherwise or indicated otherwise by context.

Particular embodiments may be implemented as hardware, software, or a combination of hardware and software. As an example and not by way of limitation, one or more computer systems may execute particular logic or software to perform one or more steps of one or more processes described or illustrated herein. Software implementing particular embodiments may be written in any suitable programming language (which may be procedural or object oriented) or combination of programming languages, where appropriate. In various embodiments, software may be stored in computer-readable storage media. Any suitable type of computer system (such as a single- or multiple-processor computer system) or systems may execute software implementing particular embodiments, where appropriate. A general-purpose computer system may execute software implementing particular embodiments, where appropriate. In certain embodiments, portions of logic may be transmitted and or received by a component during the implementation of one or more functions.

Herein, reference to a computer-readable storage medium encompasses one or more non-transitory, tangible, computer readable storage medium possessing structures. As an example and not by way of limitation, a computer-readable storage medium may include a semiconductor-based or other integrated circuit (IC) (such as, for example, an FPGA or an application-specific IC (ASIC)), a hard disk, an HDD, a

hybrid hard drive (HHD), an optical disc, an optical disc drive (ODD), a magneto-optical disc, a magneto-medium, a solid-state drive (SSD), a RAM-drive, or another suitable computer-readable storage medium or a combination of two or more of these, where appropriate. Herein, reference to a computer-readable storage medium excludes any medium that is not eligible for patent protection under 35 U.S.C. §101. Herein, reference to a computer-readable storage medium excludes transitory forms of signal transmission (such as a propagating electrical or electromagnetic signal per se) to the extent that they are not eligible for patent protection under 35 U.S.C. §101. A computer-readable non-transitory storage medium may be volatile, non-volatile, or a combination of volatile and non-volatile, where appropriate.

This disclosure contemplates one or more computer-readable storage media implementing any suitable storage. In particular embodiments, a computer-readable storage medium implements one or more portions of interface **102**, one or more portions of processor **104**, one or more portions of memory **110**, or a combination of these, where appropriate. Analogous portions of mainframe **200** and database **300** may also be configured in this manner. In particular embodiments, a computer-readable storage medium implements RAM or ROM. In particular embodiments, a computer-readable storage medium implements volatile or persistent memory.

This disclosure encompasses all changes, substitutions, variations, alterations, and modifications to the example embodiments herein that a person having ordinary skill in the art would comprehend. Similarly, where appropriate, the appended claims encompass all changes, substitutions, variations, alterations, and modifications to the example embodiments herein that a person having ordinary skill in the art would comprehend. Moreover, reference in the appended claims to an apparatus or system or a component of an apparatus or system being adapted to, arranged to, capable of, configured to, enabled to, operable to, or operative to perform a particular function encompasses that apparatus, system, component, whether or not it or that particular function is activated, turned on, or unlocked, as long as that apparatus, system, or component is so adapted, arranged, capable, configured, enabled, operable, or operative. For example, various embodiments may perform all, some, or none of the steps described above. Various embodiments may also perform the functions described in various orders.

Various embodiments disclosed herein may be used together in a variety of combinations. In various embodiments, software testing module **100** may have different types, numbers, and configurations of interface **102**, processor **104**, memory **110**, or any components thereof (analogous portions of mainframe **200** and database **300** may also be configured in this manner). For example, various embodiments may utilize different numbers and types of metrics **116**.

Although the present invention has been described above in connection with several embodiments; changes, substitutions, variations, alterations, transformations, and modifications may be suggested to one skilled in the art, and it is intended that the present invention encompass such changes, substitutions, variations, alterations, transformations, and modifications as fall within the spirit and scope of the appended claims.

What is claimed is:

1. A method of evaluating a software change, the method comprising:

determining, by a first computer system, that a first job has executed on a mainframe, the first job comprising one or more programs on the mainframe that utilize the software change and cause one or more first database queries to be sent from the mainframe to a database;

sending, by the first computer system to the mainframe, a first message identifying the first job;

receiving, by the first computer system from the mainframe in response to the first message, job information associated with the one or more first database queries;

generating, by the first computer system based on the job information, one or more second database queries associated with the first job;

sending, by the first computer system to the database, the one or more second database queries;

receiving, by the first computer system from the database in response to the one or more second database queries, metrics information associated with the one or more first database queries; and

determining, by the first computer system, whether the metrics information meets one or more compliance standards.

2. The method of claim **1**, wherein the metrics information comprises query performance metrics indicating resource utilization by the database during processing of the first database queries by the database.

3. The method of claim **2**, wherein the metrics information further comprises one or more of the following:

table skew metrics indicating distribution of data in one or more tables of the database;

load metrics associated with a volume of data processed by the database during the first job; and

view metrics comprising one or more parameters associated with a view received by the first computer system from the database in response to the one or more second database queries, wherein the view comprises the metrics information.

4. The method of claim **1**, further comprising:

determining a mainframe version from a plurality of mainframe versions, and determining a database version from the plurality of mainframe versions, wherein sending the first message to the mainframe comprises sending the first message to the mainframe version, and sending the one or more second database queries to the database comprises sending the one or more second database queries to the database version.

5. The method of claim **4**, wherein:

the plurality of mainframe versions comprises:

a software development version;

a testing version; and

a production version; and

the plurality of databases versions comprises:

a software development version;

a testing version; and

a production version.

6. The method of claim **1**, wherein the job information comprises job timing information indicating start and end times associated with the first job.

7. The method of claim **1**, wherein:

the metrics information comprises metrics information associated with the first job and metrics information associated with a second job; and

the method further comprises deleting, by the first computer system before determining whether the metrics information meets the one or more compliance standards, the metrics information associated with the second job.

8. An apparatus for evaluating a software change, comprising:

an interface operable to communicate through a network with a mainframe and a database;

a memory operable to store metrics information; and

a processor communicatively coupled to the interface and the memory, the processor operable to:

determine that a first job has executed on the mainframe, the first job comprising one or more programs on the mainframe that utilize the software change and causes one or more first database queries to be sent from the mainframe to the database;

send a first message identifying the first job to the mainframe;

receive job information associated with the one or more first database queries from the mainframe in response to the first message;

generate one or more second database queries associated with the first job based on the job information;

send the one or more second database queries to the database;

receive metrics information associated with the one or more first database queries from the database in response to the one or more second database queries; and

determine whether the metrics information meets one or more compliance standards.

9. The apparatus of claim **8**, wherein the metrics information comprises query performance metrics indicating resource utilization by the database during processing of the first database queries by the database.

10. The apparatus of claim **9**, wherein the metrics information further comprises one or more of the following:

table skew metrics indicating distribution of data in one or more tables of the database;

load metrics associated with a volume of data processed by the database during the first job; and

view metrics comprising one or more parameters associated with a view received by the first computer system from the database in response to the one or more second database queries, wherein the view comprises the metrics information.

11. The apparatus of claim **8**, wherein the processor is further operable to determine a mainframe version from a plurality of mainframe versions and to determine a database version from the plurality of mainframe versions, and wherein sending the first message to the mainframe comprises sending the first message to the mainframe version, and sending the one or more second database queries to the database comprises sending the one or more second database queries to the database version.

12. The apparatus of claim **11**, wherein:

the plurality of mainframe versions comprises:

a software development version;

a testing version; and

a production version; and

the plurality of databases versions comprises:

a software development version;

a testing version; and

a production version.

13. The apparatus of claim **8**, wherein the job information comprises job timing information indicating start and end times associated with the first job.

14. The apparatus of claim **8**, wherein:

the metrics information comprises metrics information associated with the first job and metrics information associated with a second job; and

the processor is further operable to delete the metrics information associated with the second job before determining whether the metrics information meets the one or more compliance standards.

15. A non-transitory computer readable storage medium comprising logic, the logic operable, when executed by a processor, to:

determine that a first job has executed on a mainframe, the first job comprising one or more programs on the mainframe that utilize the software change and causes one or more first database queries to be sent from the mainframe to a database;

send a first message identifying the first job to the mainframe;

receive job information associated with the one or more first database queries from the mainframe in response to the first message;

generate one or more second database queries associated with the first job based on the job information;

send the one or more second database queries to the database;

receive metrics information associated with the one or more first database queries from the database in response to the one or more second database queries; and

determine whether the metrics information meets one or more compliance standards.

16. The medium of claim **15**, wherein the metrics information comprises query performance metrics indicating resource utilization by the database during processing of the first database queries by the database.

17. The medium of claim **16**, wherein the metrics information further comprises one or more of the following:

table skew metrics indicating distribution of data in one or more tables of the database;

load metrics associated with a volume of data processed by the database during the first job; and

view metrics comprising one or more parameters associated with a view received by the first computer system from the database in response to the one or more second database queries, wherein the view comprises the metrics information.

18. The medium of claim **15**, wherein the logic is further operable, when executed by the processor, to determine a mainframe version from a plurality of mainframe versions and to determine a database version from the plurality of mainframe versions, and wherein sending the first message to the mainframe comprises sending the first message to the mainframe version, and sending the one or more second database queries to the database comprises sending the one or more second database queries to the database version.

19. The medium of claim **18**, wherein:

the plurality of mainframe versions comprises:

a software development version;

a testing version; and

a production version; and

the plurality of databases versions comprises:

a software development version;

a testing version; and

a production version.

20. The medium of claim **18**, wherein the job information comprises job timing information indicating start and end times associated with the first job.

* * * * *